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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/810,339	03/26/2004	Raghunath V. Chaudhari	03108/0201076-US0	8252

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EXAMINER	
WITHERSPOON, SIKARL A	

ART UNIT	PAPER NUMBER
1621	

DATE MAILED: 10/27/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/810,339	CHAUDHARI ET AL.	
	Examiner	Art Unit	
	Sikarl A. Witherspoon	1621	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 September 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-24* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-24* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *2*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 3, 7-10, 15-19, 22 and 23 are rejected under 35 U.S.C. 102(b) as being anticipated by Borgaonkar et al (Ind. Eng. Prod. Res. Dev. 1984).

Borgaonkar et al disclose a process for the liquid phase oxidation of toluene to benzaldehyde by air, in an acetic acid medium, with a cobalt acetate catalyst and sodium bromide as a promoter (abstract). The reaction is conducted at a temperature in the range of 95 to 180° C and a pressure of 1.0 to 21 kg/cm^2 (1 to about 21 bar) [table III, p 456]. The concentration of bromine with respect to toluene is shown in table IV on page 457. The reaction mixture is allowed to cool to room temperature and then filtered (p 455 column 2, second paragraph). The process disclosed by Borgaonkar et al anticipates the instant claims.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 2, 20, 21and 24, although not anticipated, are rejected under 35 U.S.C. 103(a) as being unpatentable over Borgaonkar et al.

The instant claims further limit the process of the instant invention to separation of the product by distillation, the concentration of oxygen being in the range of 1-10% in nitrogen, and 2-7% in nitrogen, and benzoic acid and benzyl alcohol being obtained as side products and a selectivity to benzaldehyde in the range of 60-75%, respectively.

The differences between Borgaonkar et al, and the instant claim limitations are that Borgaonkar et al do not teach separation of the product by distillation, do not teach the concentration of oxygen as recited herein, and do not expressly teach benzyl alcohol as a side product.

With regard to the first difference, Borgaonkar et al do not teach separation of the product by distillation; rather, they teach separation by filtration (p 455, second column, second paragraph). The examiner, however, purports that the means by which the product is separated is immaterial, absent a showing that a particular type of separation technique would afford unexpected properties, i.e., purity, etc., to the product being separated. Accordingly, the examiner purports that it would have been obvious to a person of ordinary skill in the art, at the time the present invention was made, to employ any known technique for separating products formed via a liquid phase process, including filtration and/or distillation, or solvent extraction.

With regard to the concentration of oxygen present in the oxidizing agent, as stated above, Borgaonkar et al do not teach the oxygen concentration recited in the instant claims. However, claim 1, the independent claim in the present invention,

recites the presence of *diluted* oxygen, i.e., not 100% oxygen. Borgaonkar et al conduct their oxidation process in the presence of air, which is comprised of about 21% oxygen, and nitrogen (about 75%). Applicants have not shown any unexpected benefit afforded by conducting their process in the presence of oxygen at a concentration of 1-10%. Accordingly, the examiner takes the position that it would have been obvious to a person of ordinary skill in the art to modify the oxygen concentration of the oxidizing agent, whether it is air or another oxygen-containing material. A person of ordinary skill would have been motivated to do so by the desire to provide the optimal concentration of oxygen to produce the desired oxidized compound; in the case of Borgaonkar et al, benzaldehyde. Higher concentrations of oxygen may result in higher production of the acid compound, instead of the aldehyde.

With regard to the presence of benzyl alcohol as a side product, the reference teaches that benzaldehyde and benzoic acid were the only *major* products of the reaction, but that benzyl alcohol was not obtained (p 456, third paragraph). However, it would have been obvious to a person of ordinary skill in the art that benzyl alcohol could also have been produced by varying the contact time of the toluene starting material and the oxygen concentration of the oxidant so as to afford conditions that would be favorable for the co-production of benzyl alcohol. Such modification of oxygen concentration and contact time of reactants could also be employed to obtain a desirable selectivity to the desired product, i.e., the aldehyde, acid or alcohol.

Claims 1-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kantam et al (US 6,495,726) and further in view of Borgaonkar et al.

The instant claims are drawn to a process for preparing benzaldehyde by the liquid phase oxidation of toluene in an organic solvent, and in the presence of a catalyst system comprising a transition metal(s) and a bromide source as a promoter, and in the presence of diluted oxygen, and then cooling the reaction mixture and separation the product. Further limitations include separating the product by distillation, the transition metal catalyst comprising manganese and iron or manganese and vanadium, the bromide promoter being sodium, hydrogen or zinc bromide, the solvent being an organic acid, the concentration of oxygen being in the range of 1-10% in nitrogen, and the selectivity to benzaldehyde being in the range of 60-75%, with benzoic acid and benzyl alcohol obtained as side products.

Kantam et al teach a process for preparing benzaldehyde by the liquid phase oxidation of toluene, by providing a continuous flow of air in the presence of a catalyst selected from iron, cobalt, molybdenum, and nickel, and preferably a co-catalyst selected from manganese and copper salts, a promoter and a bromine source selected from cobalt, zinc, or sodium bromide, and a carboxylic acid solvent selected from acetic, propionic, or benzoic acid, at a temperature ranging from 60 to 130° C and pressures in the range of 1-10 bars. The process also produces benzyl alcohol and benzoic acid. The amount of manganese or copper co-catalyst, with respect to toluene is in the range of 0.004-0.017 mol%, and the amount of bromide source, with respect to toluene is in

the range of 0.14-1.14 mol% (col. 4, lines 12-65). Example 2 teaches selectivity to benzaldehyde of 62.77% (col. 6, lines 5-19).

The differences between Kantam et al and the instant invention are that Kantam et al do not teach cooling the reaction mixture prior to separation of the product(s), do not *expressly* teach separation of the product by distillation, do *expressly* not teach the catalyst being comprised of a combination of manganese and iron or manganese and vanadium, at the molar ratio of manganese to iron or manganese to vanadium, as claimed herein, do not teach an oxygen concentration of 1-10% in nitrogen, and do not teach a reaction pressure of 20-70 bar.

With regard to cooling the reaction mixture prior to product separation and a reaction pressure of 20-70 bar, Kantam et al do not teach these limitations. However, Borgaonkar et al teach a process for the liquid phase oxidation of toluene to benzaldehyde by air, in an acetic acid medium, with a cobalt acetate catalyst and sodium bromide as a promoter (abstract). The reaction is conducted at a temperature in the range of 95 to 180° C and a pressure of 1.0 to 21 kg/cm^2 (*1 to about 21 bar*) [table III, p 456]. The concentration of bromine with respect to toluene is shown in table IV on page 457. *The reaction mixture is allowed to cool* to room temperature and then filtered (p 455 column 2, second paragraph). It therefore would have been obvious to a person of ordinary skill in the art, in view of the combined reference teachings, to conduct the process taught by Kantam et al at a higher pressure (higher than 10 bar), since Borgaonkar et al, teach a similar process for the liquid phase oxidation of toluene at pressure ranges up to 21 bar. One of ordinary skill would have been motivated to

modify the pressure so as to obtain such a pressure that would afford an optimal conversion of toluene to benzaldehyde in said liquid phase oxidation.

Likewise, it would have been obvious to a person of ordinary skill to cool the reaction mixture prior to separation of the product, in the process taught by Kantam et al, since Borgaonkar et al, in their similar oxidation process, teach such a cooling, prior to separation of the product. In view of both reference teachings, one of ordinary skill would reasonably conclude that the product, i.e., benzaldehyde, can be separated with or without cooling of the reaction mixture, with no adverse effect on the aldehyde product.

With regard to the means of separating the product, as stated above, Kantam et al do not expressly teach separation by distillation. Borgaonkar et al, one the other hand, teach separation by filtration (p 455, second column, second paragraph). The examiner, however, purports that the means by which the product is separated is immaterial, absent a showing that a particular type of separation technique would afford unexpected properties, i.e., purity, etc., to the product being separated. Accordingly, the examiner purports that it would have been obvious to a person of ordinary skill in the art, at the time the present invention was made, to employ any known technique for separating products formed via a liquid phase process, including filtration and/or distillation, or solvent extraction.

Although Kantam et al do not expressly teach a catalyst comprising a combination of manganese and iron or manganese and vanadium, the examiner purports that such a combination is rendered obvious, absent a showing of unexpected

results, since Kantam et al teaches that such metals as iron cobalt molybdenum, and nickel, and a co-catalyst comprising manganese or copper salts, are employed as catalyst in their process. Therefore such catalyst(s) combinations as that which is recited in the instant claims would have been apparent to a person of ordinary skill in the art. The molar ratio of these metals is not of patentable import, absent a showing of unexpected results, because a person of ordinary skill would employ the minimum ratios that would afford optimal catalytic activity in the liquid phase oxidation taught by the reference. Likewise, the molar ratio of metal with respect to toluene that is recited in the instant claims is found obvious. As suggested by Kantam et al a lower concentration of catalyst and co-catalyst slows down corrosion of the reactor (col. 5, lines 46-51). Therefore, a person of ordinary skill would have been motivated to modify the concentration of metal catalyst, with respect to toluene, in order to obtain the amount of metal catalyst that would effectively catalyze the oxidation of toluene, and also minimize corrosion of the reactor, so as to obtain optimal results.

With regard to the concentration of oxygen present in the oxidizing agent, as stated above, Kantam et al do not teach the oxygen concentration recited in the instant claims. However, claim 1, the independent claim in the present invention, recites the presence of *diluted* oxygen, i.e., not 100% oxygen. Kantam et al conduct their oxidation process in the presence of air, which is comprised of about 21% oxygen, and nitrogen (about 75%). Applicants have not shown any unexpected benefit afforded by conducting their process in the presence of oxygen at a concentration of 1-10%. Accordingly, the examiner takes the position that it would have been obvious to a

person of ordinary skill in the art to modify the oxygen concentration of the oxidizing agent, whether it is air or another oxygen-containing material. A person of ordinary skill would have been motivated to do so by the desire to provide the optimal concentration of oxygen to produce the desired oxidized compound; in the case of Kantam et al, benzaldehyde. Higher concentrations of oxygen may result in higher production of the acid compound, instead of the aldehyde, while lower oxygen concentrations may increase production of the alcohol.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sikarl A. Witherspoon whose telephone number is 571-272-0649. The examiner can normally be reached on M-F 8:30-6:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Johann Richter can be reached on 571-272-0646. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Sikarl A. Witherspoon 10/25/04

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